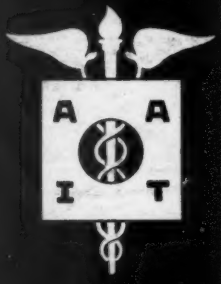
Inhalation Therapy



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AMERICAN ASSOCIATION OF INHALATION THERAPISTS

"Inhalation Therapy"

"Inhalation Therapy" is the official publication of the American Association of Inhalation Therapists, an organization of therapy technicians working in hospitals and for firms providing emergency therapy service. The Association is sponsored by the American College of Chest Physicians. Contents include news and information pertinent to the profession including medical research, operative techniques, and practical administration.

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Editorial

Whither Inhalation Therapy?

A LOT OF things are developing that make the field of inhalation therapy not only more interesting but more promising than ever before.

Among these is the interest in inhalation therapy shown by chest physicians and anesthesiologists. This has given inhalation therapy a great boost in a number of ways, not the least of which is the opening of the eyes of other doctors and administrators to the fact that inhalation therapy is an important specialty requiring and deserving well equipped professional personnel.

Locally, anesthesiologists are becoming aware of the growing complexity of inhalation therapy, and more institutions are consequently giving their inhalation therapy departments anesthesiologist supervision (or the anesthesiologists are the instigators of departments of inhalation therapy where none even existed before). This in most instances should increase department prestige by making it a department that is consulted for help on respiratory problems rather than merely one that is called when somebody needs a tent or mask. It also usually results in convincing administrators of the real need for more and better equipment, an adequate staff of properly trained personnel, sufficient quarters suitably equipped to operate effectively, etc.

Manufacturers are really extending themselves these days to improve the equipment and services they offer. The competition is healthy, and the therapist stands to gain from it in terms of better equipment, better service, more reasonable prices, etc. Equipment design is progressing—e.g., the newer flowmeters are back-pressure compensated to make them read correctly when used with new aerosol equipment which makes older flowmeters inaccurate. A few companies are even building good looks into their products, which in the past, while often utilitarian, were gawky and clumsy to handle.

Another great advancement of the cause of inhalation therapy is the steady growth of the AAIT, and the significance of the opportunities it provides its members – the most tangible being the annual meeting, this journal and chapter activities. Participation in these experiences broadens the therapist's knowledge and affords opportunity for exchange of ideas.

There is no substitute for rubbing elbows directly with other therapists and getting their views on your problems or giving them your solutions to their difficulties. Also, it is a wonderful chance to see, handle and have demonstrated to you the most up-to-date equipment. The difference between this and just looking at an advertising flyer has to be experienced to be fully appreciated.

The developments outlined above are quite exciting to the therapist, but encouraging as all these facts are, they are not merely something to sit back and rejoice in passively. These are **not** self-maintaining accomplishments, and if Inhalation Therapy is to progress as an art and a science, we must all continue to work actively to insure that they do not die in the bud.

FOUR CHAPTER CHARTERS PRESENTED AT NEW YORK

THE GROWTH of the American Association of Inhalation Therapists was emphasized at the Seventh Annual Meeting, November 12-16, by the presentation of four chapter charters; one to each of the following organizations: Illinois Chapter; Florida Chapter (Florida Inhalation Therapists Association); Michigan Chapter (Michigan Society of Inhalation Therapists); and the Greater New York City Chapter.

The presentations were made at the official meeting of the membership by Sister Borromea, president of AAIT and Sister Yvonne of the Board of Directors. Accepting the Charters were Larry Fruik for Illinois, Bruce Boyd for Florida, Jerry Heydenberk for Michigan and Joseph Klocek for New York.

This year's meeting, the Association's first in New York, drew 154 registrants — an increase of more than 30% in comparison with the 1955 meeting. Twenty states and Canada were represented. Howard Skidmore, who has been first vice president for the past three years, was elected president. Serving with him during the next year will be James Peo, first vice president, Don Gilbert, second vice president, and Larry Fruik, Treasurer. Directors are, Sister M. Borromea, one year, Dorothy Braeger, one year, Noble Price, two years, Sister M. Yvonne, two years, James Whitacre, one year, Jack Sharkey, three years, and Sister Rudolpha, ex officio.

Coupled with the growth of the Association is a growth in the demand for competent therapists, and the hospital without an inhalation therapy department is behind the times, it was pointed out by a panel consisting of Drs. Alvis Greer, Houston, Texas; Gordon Wyant, Saskatoon, Saskatchewan; and Vincent Collins, New York, New York. Dr. Wyant also gave the therapists some pointers on "Organizing an Inhalation Therapy Department," emphasizing the need to plan for 24-hour coverage, proper maintenance and control of equipment and for adequate training and medical supervision.

Standards for the training of inhalation therapists received much attention at the meeting. Dr. Edwin Emma, New York, New York, described the work which has been done by the New York State Society of Anesthesiologists and the New York State Medical Society (see Inhalation Therapy, Volume 1, No. 3, August, 1956, Page 8). Dr. Emma stated that establishing schools was not enough and that a registry of qualified personnel should be given serious consideration.

It was pointed out that the interim problem before schools can be set up makes standards and registry considerations somewhat idealistic for the present. Two categories of specialization may be required. Many institutions are not prepared to pay for a person as highly specialized as the suggested

The members of the New York delegation proudly display the charter granted to the Greater New York City Chapter. Joseph Klocek, holding the charter, is president of the Chapter.

standards require. At the same time, there is a demand for persons who are familiar with inhalation therapy equipment and its applications that is not being met.

Mr. Jerome Heydenberk, Kalamazoo, Michigan, discussed "Public Relations for the Therapist" at the technical session at which association members presented papers. He pointed out the need for the benefits to be gained from a proper approach to the physician, the nurse, the patient and the patient's family or visitors. In the case of the doctor, tact must be used in suggesting methods or improvements he doesn't think of. With the nurse, cooperation is the keynote: she needs to be familiar with techniques being used, as she must look after the patient when the therapist cannot be present. The therapist should explain exactly what he is going to do, so the patient knows what to expect. The therapist's public relations extend even to the patient's family or other visitors, because it is especially important to caution them against smoking in the room while oxygen is being administered.

Max Glasser of Miami covered "Services Outside the Hospital." Big hospitals with well-established inhalation therapy departments are the exception rather than the rule, Mr. Glasser says, and because of this the rental service agencies' work extends not only to patients at home but also into smaller hospitals, and even at times into larger ones. One of the big problems arising from this broader coverage is the need to stock all available equipment, because different doctors and hospitals order different kinds of masks, tents, and other equipment.

Howard Skidmore of Detroit discussed "Safety and the Inhalation Therapist," and the recommendations of the National Fire Prevention Association's Pamphlet No. 565 on pipeline standards, and precautions in use of tents.

Noble Price of Indianapolis

talked about improvising equipment to meet unusual situations or to substitute for unavailable apparatus. One of the highlights of his remarks was an account of placing an oxygen tent over a patient's legs to give topical application of oxygen to an infected wound.

Leroy Allen of Philadelphia described a number of common errors made by inexperienced personnel in handling inhalation therapy equipment. He recommended the use of check lists of things to look for when trying to find out what is wrong with a given piece of apparatus or with the way it is set up.

Following are abbreviated annotations of the speeches given during the lecture series that began Tuesday morning and ran through Friday noon:

Dr. Peter Theodos (Philadelphia): Pressure Breathing

Among things IPPB does are following: (1) increases ventilation and effectively blows off CO_2 (2) improves bronchial drainage, (3) gets aerosols and oxygen into otherwise relatively inaccessible areas of the lungs, (4) gives more uniform alveolar aeration in all parts of the lungs, improving respiratory gas exchange with blood, (5) is an effective form of deep breathing exercise that develops diaphragm and intercostal muscles, (6) tends to minimize capillary exudation.

Members of the Florida Chapter gather around Sister Borromea, President of AAIT, to examine their Charter.

Around 20% of patients selected for this treatment are not benefited, but 40% are moderately improved and 40% very much improved. It is not a quick cure (nor even a *cure* at all); Dr. Theodos says treatments often should go on for 3 to 6 weeks. The patient should learn

Dr. Virginia Apgar Dr. Vincent Collins

to use the IPPB machine in the hospital, and then when improved sufficiently should continue the treatments at home.

Dr. Edwin Levine (Chicago): Controlling Diseases of the Chest

Damage most usually involves the bronchi, where there may be narrowing caused by bronchospasm, edema, obstructions or by outside pressure (as from a tumor). Since they narrow and shorten on expiration anyway, the further narrowing due to disease may make cough not only ineffective but very damaging because obstructed airways cause development of abnormally high pressures in the lungs—up to 140 mm of mercury (40 mm pressure is sufficient to tear alveoli). IPPB coupled with aerosol bronchodilators is most effective way to keep bronchi open enough during expiration to make cough effective. It also facilitates getting air beyond the mucus plugs: without the bronchodilator and IPPB, the pressures developed merely push plugs farther down into lungs instead of getting air behind them that the cough can carry out. Aerosol therapy to be effective requires at least 30 minutes for water and detergents to loosen tenacious sputum.

Dr. Virginia Apgar (New York): Resuscitation

No means of resuscitation accomplishes anything if airway is not open; first thing to do is test for patency by putting palm in front of patient's mouth or observing whether region just below clavicles moves. Commonest obstruction is tongue fallen back into pharynx—lift chin and/or

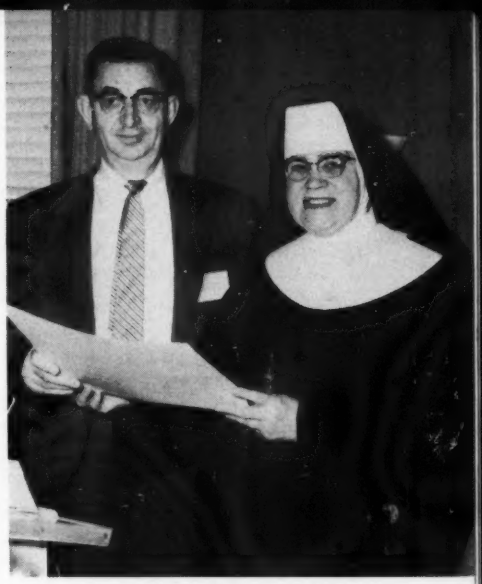
pull tongue forward and fasten it. When going to a resuscitation case, it is well to carry a nasopharyngeal airway and a sharp knife—the latter for emergency tracheotomies. Mouth-to-mouth or mouth-to-nose artificial respiration is more effective than Holger-Nielson manual method, and is less work too. Forty to 60 cm of water is amount of pressure often required to inflate the lungs of newborn infants; however, this pressure must not be applied for longer than ¼ second at a time or rupture of the lungs may occur.

Dr. Alvan Barach (New York): Physiologic Basis of Inhalation Therapy

Pulmonary emphysematous patients are *said* not to be sensitive to CO_2. Barach said Cherniak showed they are by using bronchodilators. Evidently the mechanism of response to CO_2 is dependent on size of orifices, and that in the emphysematous the size cannot be increased reflexly as in the normal person. As soon as bronchi are dilated, the response to CO_2 is same as in normal individual. Dr. Barach recommends use of nasal cannulae to get desired low percentages of oxygen for these patients. Whereas emphysematous patient on O_2 does have an initial rise in CO_2, after a while the O_2 improves lung function and CO_2 then comes down automatically. He advocates various postures which bring diaphragm into fuller excursion to improve ventilation.

Dr. Hylan Bickerman (New York): Aerosol Therapy

Since aerosols may be used to treat a number of disease entities, one must decide the site at which aerosol should be deposited and then choose appropriate nebulizer—one producing fine particle size for alveolar deposition, one giving coarse mist for sinuses, larynx and upper respiratory tree. Maximum deposition occurs when respirations are slow and deep, and with period of apnea between inspiration and expiration. Patients develop tolerance to bronchodilators; watch for this and switch to another dilator when it occurs. Antibiotic of choice depends on sensitivity of organism present, and upon patient's allergic status. Terramycin is irritating and prone to exacerbate bronchospasm in those having any. Enzymes also quite irritating and can only be used a short time.



Sister Borromea, President of AAIT, presents the Michigan Chapter Charter to Jerome Heydenberk, President of the Michigan Society of Inhalation Therapists.

Dr. Gustav Beck (New York): Bronchial Drainage

Cough is best mechanism for eliminating secretions, but is effective only from larger bronchi to mouth; it cannot remove things below bronchi. Adequate ventilation is important in getting things up to bronchi; secretory activity of lining helps liquefy sputum, and peristaltic and ciliary action move it upwards into bronchi. Continuous positive pressure helps keep bronchi open during expiratory phase and thus helps cough, as do broncholdilator drugs. Exsufflation with Negative Pressure (EWNP) will not rupture sutures, even though normal coughing will. Latter produces intragastric pressure of 90 mm mercury, whereas EWNP produces only about 25-30 mm. EWNP not recommended for children under 4. Pursed lip breathing is a good natural type of positive pressure breathing helpful in pulmonary edema.

Dr. Albert Andrews (Chicago): Acute Obstructive Diseases

In infants commonest causes of difficulty are foreign bodies and bronchiolitis; in older children it is acute laryngotracheo-bronchitis ("Croup"). Best treat-

ment is very high humidity with oxygen. Patient will often get worse at first, because secretions increase in bulk as they are liquefied. After 2 or 3 hours, the child usually gives a cough and raises a lot of stuff, after which improvement is steady. Humidity is all-important for tracheotomy patients, and the smaller the child the greater the need. Bronchial asthma patients (adult) in status asthmaticus are best treated with first a tranquillizer, then metacortisone followed by IPPB using a bronchodilator and He-O_2 instead of oxygen.

Dr. M. I. Levine (New York): Bronchiolitis and Pneumonia in Infants

In these patients the bronchiolar walls and alveoli thicken, interfering with gas uptake. The capillaries exude fluid into the alveoli and fill them. The sticky serous fluid tends to dry and make the alveoli impervious to gas exchange. Give oxygen with the highest humidity possible to keep this drying from happening and to help get oxygen across. In a child, never wait for cyanosis! Any child with high pulse and respiratory rate, especially if retracting, should be put in high humidity oxygen at once. Sometimes 5% CO_2 is helpful, by virtue of slowing and deepening the respirations, so that patient gets more oxygen.

Dr. M. S. Segal (Boston): Smoke, Gas and Fume Poisoning

Try to get medical history of patient from relatives before commencing treatment. If he has a chronic cough, treatment with 100% Oxygen might be disastrous, whereas it is definitely desirable if such a contra-indication doesn't exist. Inflam-

Sgt. Felix Hanratty of the Emergency Service Division of the New York City Police Department discusses a piece of equipment with Bob Kruse, member of the Illinois Chapter of AAIT.

Dr. Peter Theodos Dr. Alvan Barach

matory exudates obstruct airway, which must be evacuated by expectorants, positive pressure therapy, postural drainage, bronchoscopy, etc. Adequate provision must be made for removal of secretions loosened by aerosol IPPB treatments.

Dr. Charles Letourneau (Chicago): Prevention of Retrolental Fibroplasia

The evolution of RLF was traced from the days when there was **no** oxygen in incubators through the days of too much to the present case of controlled percentages of oxygen. Process of RLF described as follows: blood vessels of the retina get gorged and tortuous when high O_2 concentration continues long in premature eyes. During active stage, they get so contorted they often break and cause small hemorrhages. Even after this has occurred, regression to normal vision usually occurs if oxygen is withdrawn. However, if it persists, the hemorrhaging continues and scar tissue grows out into the vitreous humour behind the lens. This is the final and irreversible stage, as the scar is opaque. Both active and final stages of RLF seem related directly to the **duration** of oxygen therapy, and not to the concentration employed nor to the rate of withdrawal from high concentrations. Also, oxygen adversely affects only infants under 3 pounds, or up to the 7th month of gestation.

Dr. Alvis Greer (Houston): Tent Therapy

Tents are costly themselves, and use so much more gas than other forms of therapy that tent therapy becomes an economic consideration. One of the dangers of tent therapy in hospitals which are not piped for oxygen is that nurses or other personnel often allow cylinders supplying tents to run out and fail to replace them promptly. Another point

(Please turn to page 26)

SOCCER OR *SOROCHE*

By HERMANN RAHN, PH.D.*

WHEN I finally reached the top of the "hill," the name affectionately attached to the isolated mining town of Morococha, Peru, I was no longer certain that my journey had been worthwhile. During the next few hours I became even more convinced that all my months of planning to be here had been a mistake. By that time, I was snitching discarded overcoats and sweaters from my colleagues in a vain attempt to get warm. When no one was looking, I pushed two electric heaters over near my chair, swallowed aspirin tablets to allay a splitting headache, and moved away from the nearby kitchen in order to banish the thought of food and control my nausea.

The "hill" was exactly 15,000 feet high, and I was suffering from *soroche*, or high altitude sickness. I finally propped my head up and gazed out of the window on a startling scene. Directly below was the soccer field where the mining company's teams in regular outfits were battling with the usual vigor and spirit for the local championship, after a full day's shift in the copper and silver mines. Above them the bare, snow-covered mountains rose another 3,000 feet, framing this amazing spectacle of Indians, llamas, children, buses, bicycles and dust. Urchins were selling the latest copy of *Life* magazine, Indian women in their colorful garb and straw hats were carrying their babies on their backs and spinning wool as they walked along to the game. Chickens and dogs and children competed for attention, while proud pack-llamas slowly picked their way through the streets with great dignity and disdain.

This, then, was the far-off place to which I had eagerly travelled to observe and study people living at high altitudes. Through the generosity of the Rockefeller Foundation it was possible to work at the best equipped high altitude laboratory in the world, located at 15,000 feet—some 500 feet higher than the highest peak in the United States. My own malaise was typical for anyone quickly transported to this altitude where the oxygen pressure in the lungs and blood is exactly half of what it was a few hours before at Lima, Peru. *Soroche* may last for days, and one's appetite may not return for weeks. Mentally one operates below par, even making mistakes in simple additions and multiplications during routine laboratory work. Sleep during the first days is very disturbed,

*Reprinted, with modifications and additions, from *Rochester Review*, March 1956.

From left to right, Drs. Hermann Rahn, Tulio Velasquez and Alberto Hurtado. Mountains in background are typical of the 16,000 foot pass just above the Institute of Andean Biology at Morococha, Peru, where Drs. Velasquez and Hurtado have done research for many years.

and the slightest exertion provokes a breathlessness which fills one with great admiration for the soccer players. That anybody can joyfully submit himself to such an ordeal after a day's shift in the mine seems absolutely miraculous to a newcomer still fighting *soroche*.

Fortunately, one slowly becomes adapted to this new environment and can look more objectively at the natives who have lived for generations in these regions. Over forty percent of the total population of Peru resides above 9,000 feet, and the study of their bodily functions and adaptations has been one of the major concerns of Dr. Alberto Hurtado, who was responsible for the erection of this Institute of Andean Biology at Morococha. Both Dr. Hurtado and his associate, Dr. Tulio Velasquez, had previously spent several years of research in respiration physiology at the University of Rochester School of Medicine, and their pioneer work in Peru has contributed much to the physiological description of altitude people.

Not only are the natives' lungs larger and their ventilation greater, but the blood volume is increased. About a quart and a half of red cells are added to their blood stream. These are all devices for maintaining proper oxygenation of the tissues in the rarified atmosphere.

The effective alveolar ventilation of these people (at rest) is 70% larger than ours is at sea level. This

is accomplished by deeper rather than faster breathing. It has been thought that the increased ventilation was due to an anoxic drive via the cartoid chemoreceptors, since 100% oxygen given to the unacclimatized person at this altitude promptly reduces his ventilation to that at sea level. However, 100% oxygen given the individual acclimatized to 15,000 feet altitude does **not** reduce the ventilation at all. It is thus clear that the larger ventilation of the natives is **not** dependent upon chemoreceptor activity.

It seems therefore more likely that the increased respiratory drive is due to an increased sensitivity of the respiratory center to CO_2. At sea level, the center is driven by an arterial pCO_2 of about 40 mm Hg; at 15,000 feet this value is only 30 mm in an acclimatized person. This would correspond to CO_2 concentrations **at sea level** of 6% and 4% respectively. Since the respiratory drive of the natives at this altitude has been demonstrated not to be due to lowered O_2 tension, and we know that the CO_2 is lower up there, then it would appear that the

One of the more astounding things at Morococha, to the author, who suffered from *Soroche* during his stay at 15,000 feet was the soccer games played by the miners after spending a full shift in the mines. Only those adapted to the high altitude could carry on this type of physical exertion. In accordance with Indian custom the women in straw hats in the foreground maintain a discreet distance from the men at this public function.

respiratory center is sensitive to markedly lower CO_2 concentrations at high altitudes than it is at sea level.

Under these conditions it is not so surprising to find that the breath-holding time at 15,000 feet is reduced to only 30% of that at sea level. No underwater swimming records are expected at this altitude!

80% Saturation

At sea level, the oxygen saturation of the hemoglobin of the red blood cells is 97%; but at 15,000 feet the saturation is only 80% even in the acclimatized person. This is due to the difference in alveolar partial pressure of oxygen at the two extremes, namely, 100 mm Hg at sea level and only 50 mm in the natives at 15,000 ft. Here is where that extra quart and a half of red cells helps increase oxygen-carrying capacity of the blood by making up for the lesser amount each cell can carry.

Other interesting differences which have a direct bearing on their respiratory adaptation to high altitude are: much slower heart rate and lower blood pressure, but nearly normal cardiac output values. The resting heart rate is only about 55, as compared with about 70 for adults at sea level; and systolic blood pressure around 100 instead of 120. Even more remarkable is the fact that during exercise the natives' blood pressure scarcely rises at all! The low blood pressure, slow heart rate and absence of coronary disease and leukemia in these people suggest intriguing problems for future studies.

One of the great advantages of the Institute of Andean Biology is its proximity to a major medical center. When parts of the roads are not washed out, it can be reached in four hours by car from San Marcos University in Lima, the oldest university in the Americas. Only two major roads completely cross the thousand-mile Andean chain of Peru. This incredibly rugged barrier thus isolates the populated coastal region from the much larger Peruvian Amazon basin. Winding one's way up through the bleak and arid mountains studded with cactus, agave and eucalyptus, with hairpin turn after hairpin turn, one leaves the donkey behind and enters the remote realm of the llama. Finally reaching a pass at 16,000 feet, the road drops down on the other side where the waters now drain into the Amazon and the Atlantic Ocean.

The utter primitivenes of the Andean Sierras is a startling contrast to the cosmopolitan city of Lima, with its million inhabitants, many modern buildings, elegant shops and heavy traffic. Once away from the city, the bleak and impressive landscape is only interrupted by adobe huts, mining camps and fantastic terraces carved from the steep and barren mountainsides. This ancient Inca tradition of wresting from the hills these tiny areas of tillable soil is still continued today, and agricultural methods seem unchanged since the Spanish conquest.

The modern road provides a sharp contrast to the old tradition. Esso gas stations now dotting the roadside are even equipped with rest rooms with modern plumbing,

which must provide a constant source of wonder and amazement to the primitive mountain dwellers who are accustomed to the freedom of the whole countryside. To them it serves as a unique example of the price man pays to drive a car. On the other hand, other products are more readily accepted by these descendants of the Inca, and their traditional chicha beer is giving way to Coca-Cola and its more romantic-sounding competitor, Inca-Cola.

If one continues down the eastern side of the Andes, the scenery rapidly changes. The wild mountain streams on this side are now flanked by lush vegetation as one descends into the rain forest of the Amazon. Within a few hours, the land of the llama and condor and the arid altiplano is exchanged for huge trees, lianas, parakeets and the tapir. This is Peru's newest frontier. The roads are slowly pushing further into the jungle, and on my trip to the farthest outpost, the last 100 miles was travelled on a one-way road—east on Monday, west on Tuesday, etc.

Thus the three lands of Peru provide startling contrast and variety. The Spanish settled primarily along the Pacific coast, and Lima has become the cultural and business center, while on the east side of the mountains remain the vast and nearly untapped resources of the Amazon. In between lies the lofty Andean home of the ancient Inca empire. Even today their descendants prefer the high altitudes and provide one of nature's fascinating experiments — acclimatization of man to low oxygen pressure.

The two-story brick building is the Institute of Andean Biology located in a Peruvian mining town at an elevation of 15,000 feet. Indian miners and their families live in the building in the foreground, sharing their facilities with their chickens and dogs. The author and his colleagues made studies of oxygenation of the blood and alveolar ventilation of the people living in this high altitude.

SAFE PRACTICE

in Oxygen Therapy

By JOHN A. HOUSE*

HANDLING OXYGEN *does* present some problems. Safe, effective oxygen therapy is the result of careful planning. To appreciate the precautions necessary for safe handling of oxygen in hospitals, some facts concerning oxygen should be reviewed.

Oxygen Characteristics

Oxygen is not combustible. It is a non-flammable gas. It does not burn nor can it form explosive mixtures when mixed with air. But oxygen does support combustion and because it does so, some forms of oxygen administration are possible fire hazards.

Nothing will burn unless oxygen is present. The higher the concentration of oxygen available, the greater is the intensity of burning. A lighted cigarette smoldering in room air may burst into flames when introduced into an atmosphere containing more than the normal amount of oxygen. Oxygen-enriched atmospheres developed within closed circuit administering apparatus, such as tents, hoods, and incubators, represent potential fire hazards.

Other factors that must be considered in handling oxygen are the weight and top-heaviness of oxygen cylinders and the high pressure of a full cylinder — usually 2200 pounds per square inch. Oxygen cylinders themselves are sturdy containers. They are constructed with full consideration for the pressures that they are to hold. The law requires that they be tested and inspected at least once every five years. The test dates must be clearly stamped on them. Both cylinders and cylinder valves are maintained carefully. Oxygen in the cylinders meets standards established by the United States Pharmacopoeia. The hazard with cylinders, therefore, is not created by their construction or contents, but rather by lack of care in their handling.

Where cylinder oxygen is the method of supply, hospital authorities must first provide for adequate receiving facilities. The receiving platform should be of truck height to lessen the chance of accidents during delivery. Oxygen should be stored in a room located near the receiving platform to minimize handling of cylinders in quantity within the hospital building.

Storage

An oxygen storeroom should have a one-hour fire resistance rating. If more than six cylinders are stored at one time it should be vented to the outside of the building. The room should not open directly into locations where combustible anesthesia gases are used or stored. Combustible materials, such as ether, cyclopropane, and ethylene, should not be stored in the same room with oxygen. In

*Reprinted from Hospital Management

fact, the room should not be used for the storage of any other materials, with the possible exception of nonflammable gases, oxygen therapy apparatus, and supplies. Wherever oxygen is stored or used, smoking and all other possible sources of ignition must be prohibited. These same precautions should be observed in manifold rooms of hospitals that have piping systems.

Oil, grease, and other combustible substances should *never* be permitted to come in contact with oxygen cylinder valves, regulators, gauges, or fittings. When subjected to oxygen under high pressure, they may ignite and burn with explosive violence.

Oxygen cylinders must never be stored near sources of heat, such as boilers, furnaces, steam pipes, and radiators. Heat can cause an excessive rise in the pressure of oxygen in a cylinder. Cylinders are equipped with safety release disks that open automatically to release oxygen before the pressure can increase to a dangerous level. But when a safety disk bursts, all oxygen in the cylinder escapes. This may tend to create a hazardous atmosphere. The bursting disk also makes a good deal of noise which may be startling.

Safety requires that full, partially full, and empty cylinders be kept in separate sections of the storage room. Cylinders containing other nonflammable gases, such as carbon dioxide, carbon dioxide-oxygen mixtures, helium-oxygen mixtures and nitrogen, which may be stored in the same room, should be clearly marked and kept separate from

Wherever oxygen is administered, a "No Smoking" sign must be prominently displayed.

oxygen cylinders. This will help prevent error when a cylinder of oxygen is to be delivered to a patient's bedside.

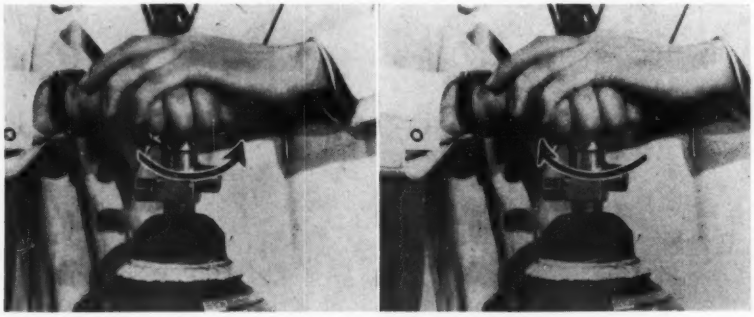
When oxygen cylinders are moved within a hospital, they should be securely strapped to a four wheeled cart. The protective valve cap, with which each cylinder is equipped by the oxygen supplier, should be left on the cylinder until it is fastened to the cart. This is done so that the valve cannot be brushed open or damaged if the cylinder is tipped over accidentally. When the cylinder is delivered to a patient's room, it should be strapped at the top and bottom to a bedpost or secured in an out of the way spot where it cannot be knocked over.

Oxygen Administration

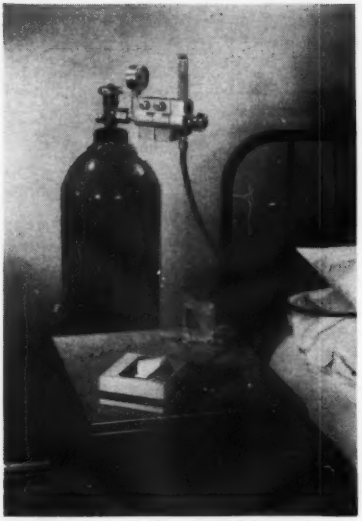
Whenever oxygen is used from a cylinder, a regulator or reducing valve must be attached. The regulator has the double duty of reducing the high cylinder pressure to a workable level and of then delivering oxygen to the administering equipment at an accurately calibrated rate. Oxygen must never be administered from a cylinder without a regulator.

Only carefully trained personnel should be allowed to attach a regulator to a cylinder. The cylinder valve must be *"cracked"* before the regulator is attached to the cylinder to blow out any dust or other foreign material that may have lodged in the valve outlet. Before the cylinder valve is opened, the flow adjusting valve of the regulator must be closed so that a sudden rush of oxygen will not damage the regulator. A person attaching a regulator to a cylinder must stand to one side of the pressure gauges when the cylinder valve is first opened.

Some hospitals that are piped have as their source of supply a bulk oxygen storage unit. These hospitals do not use cylinders and, therefore, do not have to concern themselves with the problem involving their safe handling and storage. Safety of supply in these institutions depends upon determination of a proper location for the bulk unit and on an approved oxygen piping installation. Oxygen piping today is installed under standards recommended in National Fire Protection Association Pamphlet No. 565. This assures safe delivery of oxygen to the patient's



To crack a cylinder valve, open it slightly, then close it again quickly.



Bedside cylinders must be secured where they cannot be knocked over.

bedside through a dependable distribution system.

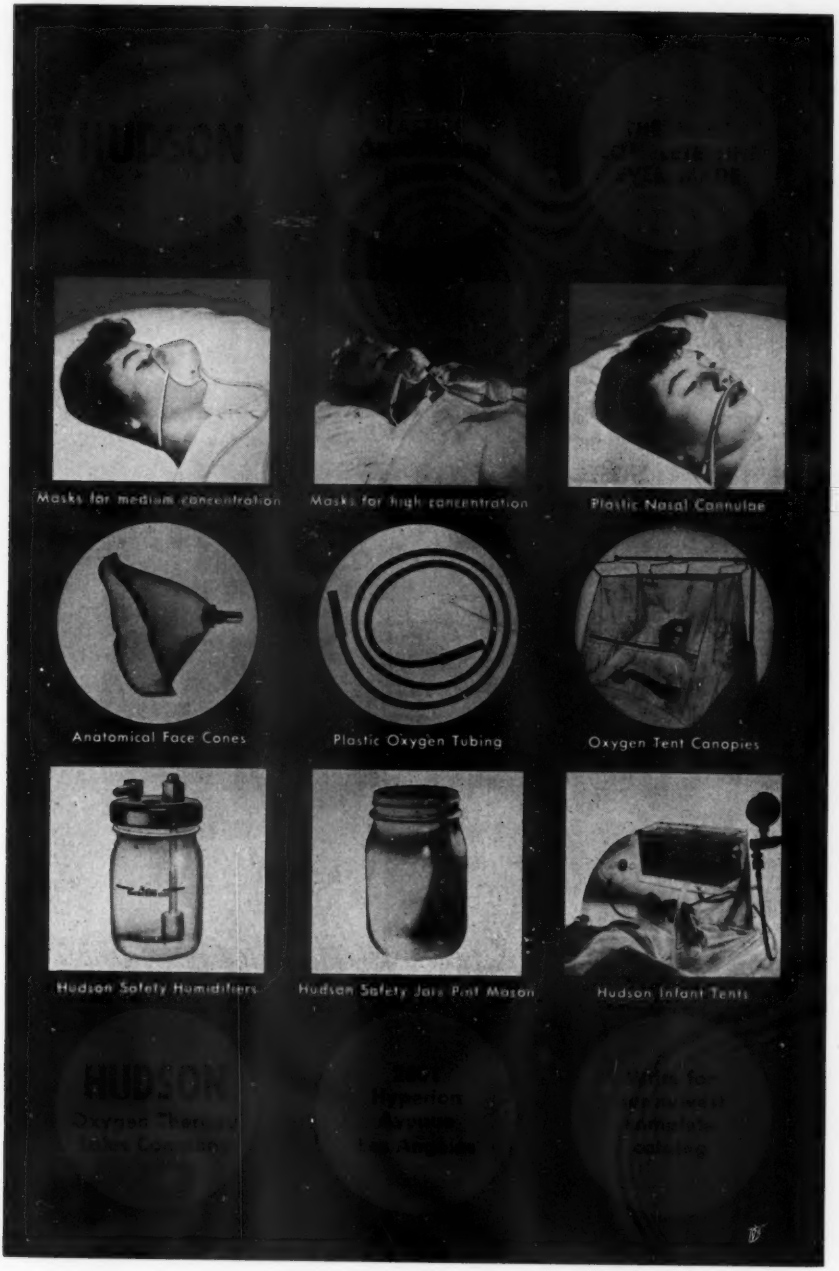
Where oxygen is delivered through a piping system, it is under about 50 pounds per square inch pressure instead of the much higher cylinder pressure. For this reason, the regulating equipment necessary at the point of use is simpler and safer to handle than is the comparable equipment needed when cylinders are used. The method of connecting a flowmeter to a piping outlet depends upon the design of the outlet.

Safe oxygen therapy depends not only on providing a supply of oxygen at the patient's bedside, but also on delivering the required concentration of oxygen into the patient's lungs. Several measures must be taken to assure effective administration of oxygen. One is the selection of dependable equipment. Most oxygen therapy regulating and administering equipment is carefully designed for its intended job. Much of it has been submitted to Underwriters' Laboratories, Inc. for testing and listing as meeting its standards. Careful selection of apparatus prior to purchasing will provide the hospital with efficient equipment with which to work.

Equipment Maintenance

Good equipment must be carefully maintained. This calls for the establishment of a well organized maintenance program. To make certain that equipment receives proper attention, all major items should be numbered and records of inspection dates and repairs should be kept. An oxygen regulator for cylinder use or a flowmeter for piping systems should be checked out by its number to the patient when in use and then checked back into the central storage room when no longer needed. Before it is assigned to another patient, it should be tested for leaks and for accuracy. Concentrations required for some oxygen therapy procedures can only be determined by liter flow. In such cases the flowmeters' ability to record flow accurately is of vital importance.

Oxygen masks, humidifiers, tents, and other apparatus should also be identified by number so that inspection between uses can be assured and recorded. This is particularly important with oxygen tents. Oxygen concentration within tents should be analyzed while the tents are in use. Low concentrations in a tent can be caused by the restlessness of the patient, by the use of


Masks for medium concentration
Masks for high concentration
Plastic Nasal Cannulae
Anatomical Face Cones
Plastic Oxygen Tubing
Oxygen Tent Canopies
Hudson Safety Humidifiers
Hudson Safety Jars Pint Mason
Hudson Infant Tents

other equipment, such as intravenous tubing, that makes proper sealing of the tent canopy impossible, or by mechanical failure of the tent itself. This latter fact can most easily be discovered if oxygen tents are numbered and if their average performance on various cases is recorded.

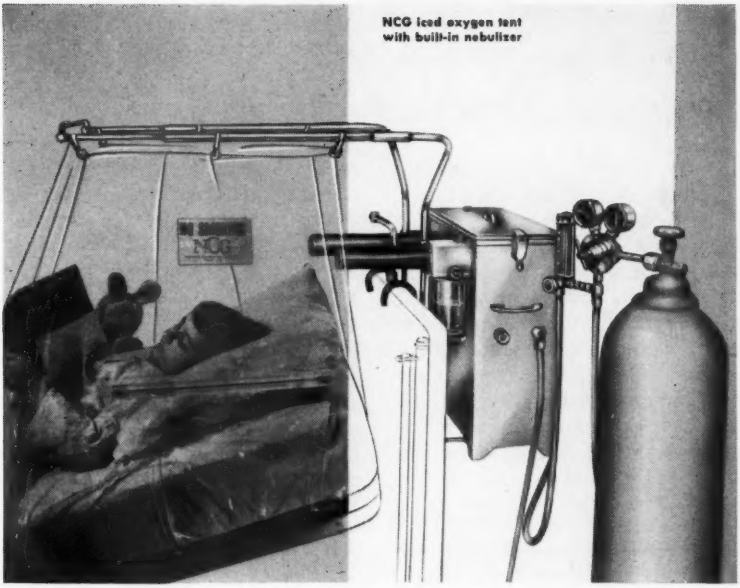
Even properly maintained equipment will not deliver the desired concentrations of oxygen unless it is operated by personnel who thoroughly understand it. Knowledge of apparatus is necessary to insure that basic precautions are followed in the assembly and operation of the various types of administering equipment. Catheters must be properly lubricated and inserted, and they must be changed at regular intervals.

Oxygen delivered by nasal catheter must be moistened in humidifiers. These humidifiers should have safety relief valves to prevent rupture of the bottles if the tubing to the patient should be obstructed. Oxygen flow delivered to masks must be high enough to satisfy the patient's requirements. Concentration meters, where used, must be set at the correct concentration. Positive pressure devices should be handled only by persons thoroughly familiar with their operation. Tents, incubators, and similar closed circuit equipment require special precautions to avoid creating potential danger from fire. All sources of ignition, such as open flames and electrical appliances, must be excluded from the vicinity of the equipment. The concentration of oxygen within such equipment must also be checked at regular intervals with an oxygen analyzer.

Oxygen is Prescribed

Oxygen, like any medicine, is prescribed in various dosages. To administer according to prescription is an important part of a hospital's service. Dr. Charles U. Letourneau has described the hospital's responsibility in this matter by saying: "having prescribed, the physician has discharged his obligation. The rest is up to the hospital to administer the treatment as prescribed." Carrying out the physician's prescription is a vital part of safe, effective oxygen therapy. This can be successfully accomplished by a continuous educational program that brings to all hospital personnel associated with the handling of the equipment, up-to-the-minute information on basic therapy procedures, as well as on the latest developments in apparatus and techniques.

To fulfill all of these requirements, which together provide the necessary conditions for good, effective, safe inhalation therapy, a hospital should place the entire responsibility for the operation of this phase of its work in one person's hands. The inhalation therapist can supervise the selection of new apparatus, its maintenance and its operation. He can make certain that all rules of safety are carefully observed, be the clearing house for technical information on inhalation therapy and the apparatus used in its administration, and see that all of those concerned are always kept fully informed. If a competent inhalation therapist is given the authority and facilities with which to work, safe and effective oxygen therapy will result.



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PATENT PENDING

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ANNUAL MEETING

(Continued from page 12)

Dr. Greer made is that older patients and younger ones require somewhat higher temperatures inside the tent than do average adults. He says that frequent analyses are the best way to find out whether patient is getting prescribed concentration.

Field Trips

Tuesday noon the group was addressed by Sgt. Hanratty of the Emergency Service Division, N.Y.C. Police Dept. about oxygen therapy in police emergency work, and that night a trip was taken through the headquarters of the emergency service division, where police officers put on demonstrations of artificial respiration, and a very impressive array of emergency rescue equipment displayed and demonstrated. The department had some 23,000 calls last year, about half of them involving oxygen therapy.

Wednesday noon Dr. Barach summarized that morning's remarks and invited the group to visit his laboratory at Presbyterian Medical Center. Several films were shown depicting the development of various apparatus, such as the lung immobilizing chamber, etc., and the morning's discussion was extended informally into a question period.

Thursday noon Jean Detert of Chicago discussed "Nursing and Inhalation Therapy." The Inhalation Therapy Department should provide equipment and technical personnel; the Nursing Department should only assist with the service and supervise it in the absence of the therapists, she said. Equipment must be maintained by the Inhalation Therapy Department and be brought to the patient in good condition. The nurses must share the therapist's responsibility for safety and proper carrying out of therapy in accordance with the doctor's orders.

AMONG OUR CONTRIBUTORS

Dr. Hermann Rahn who has given us the geography lesson on page 13 of this issue is an international authority on respiration physiology. He was for many years Vice-Chairman of the Department of Physiology at the University of Rochester and is currently Head of the Department of Physiology at the University of Buffalo.

John A. House, whose "Safe Practice in Oxygen Therapy" we are reprinting from HOSPITAL MANAGEMENT, is affiliated with the Linde Air Products Co. of Chicago. He was just elected chairman of the Rules Committee of the Greater Chicago Chapter of the AAIT.

INHALATION THERAPY ABSTRACTS

"Re-assessment of Value of Oxygen Masks that Permit Rebreathing," by J. E. Cotes, B.M., M.R.C.P., in *British Medical Journal*, vol. i, page 269, February 4, 1956.

Cotes discusses the effects of breathing oxygen at same flow rate from two different types of masks—one, the Haldane, is a non-rebreathing type, which would be similar to the O.E.M. meter or positive pressure masks (but without air injector), and the other the B.L.B. mask, which is a partial rebreathing type.

In a series of tests run on six normal subjects and fourteen patients of chronic respiratory disorders, he found that ventilation (i.e., the amount of air exchanged per minute) increased 52% in either group using rebreathing masks over the ventilation measured when using the other type.

It is pointed out that whereas the B.L.B. mask may be very desirable in cases where increased CO_2 tension is beneficial (as in pilots at altitudes), or not objectionable to normal individuals, the patient with a chronic chest disease already has CO_2 retention and his dyspnea is not going to be relieved by oxygen administration via a mask of this type. And frequently it would be relieved by using a non-rebreathing mask. On the other hand, the point is made that patients of this sort must be watched closely to see that ventilation is not depressed too much, as this would further increase CO_2 retention.

"Mechanical Respirator for Newborn Infants and Other Patients," by A. Robert Bauer, M.D., in *J.A.M.A.* 161:723 (June 23, '56)

Dr. Bauer has devised a machine which combines negative pressure in a chest cuirass with positive pressure in a mask facepiece. The cuirass is ingeniously divided by a diaphragm into two compartments. When the diaphragm rises, negative pressure is created below it (when cuirass is in position on a patient) and positive pressure above. Oxygen or air is admitted to the upper chamber, which communicates with the mask. Inspiratory excursion is initiated by the patient, by means of a microswitch with lever resting on the abdomen, so that slightest movement of abdominal wall actuates switch which is connected to a solenoid that operates the diaphragm. The respirator can be operated manually if patient is not breathing.

"Mechanical Factors in Distribution of of Pulmonary Ventilation," by A. B. Otis et al in *Journal of Applied Physiology* 8:427 (1956).

The American Physiological Society has granted permission to reprint here the summary of this article as it appears in the *Journal of Applied Physiology:*

"A theoretical analysis of the effects of local differences in mechanical properties on the distribution of ventilation within the lungs and on the overall mechanical behavior of the lungs has been presented. The theory has been tested with a model

system and has been applied to measurements made on human subjects.

"For the purpose of the analysis the lungs have been considered to be made up of a number of parallel pathways each consisting of a compliance (C) and a Resistance (R) in series. By using methods which apply to analogous electrical circuits it has been concluded that the distribution of ventilation would be uninfluenced by changes in breathing frequency only if the time-constants (the products of R and C) of the separate pathways are the same. On the other hand, if the time constants differ, the distribution of ventilation would alter with changes in breathing frequency. Furthermore, these changes would be accompanied by changes in the overall mechanical behavior of the lungs: both the compliance and resistance of the lungs would decrease as the breathing frequency increased.

"The theoretical analysis has been tested with a model consisting of two parallel pathways and the results were consistent with the theory. In normal young adults pulmonary compliance did not change over a wide range of breathing frequencies. It is inferred from this result that the time constants are substantially the same for the separate pathways in normal lungs, and that the distribution of ventilation is independent of the breathing frequency. In contrast, pulmonary compliance dropped with increased breathing frequencies in normal subjects with induced bronchospasm and in patients with asthma and emphysema. These observations suggest that considerable time-constant inequalities of the separate pathways existed in these instances, and that the distribution of ventilation altered with changes in breathing frequency."

"Oxygen for the Sick," by Howard A. Carter in *Today's Health* 34:30 (June 56)

A very lay account of the use of oxygen in hospitals. No credit given or mention made of inhalation therapy departments or therapists, but otherwise not a bad article for the general public. Too too bad we didn't get a plug here. . . .